

## WASHING MACHINE

### BACKGROUND OF THE INVENTION

5 [0001] The present invention relates to a washing machine.

[0002] Conventionally, there has been provided such a drum type washing machine as shown in Fig. 3 (JP 2001-149689 A). In this drum type washing machine, a load 10 inlet/outlet opening 101a is formed in a front face of a housing 101, and a door 103 for opening/closing the load inlet/outlet opening 101a is pivotably fitted to the housing 101 with hinges. It is noted that reference numeral 111 in Fig. 3 denotes an operation panel.

15 [0003] In the drum type washing machine of having the above construction, the door 103 is opened forward about the hinges so as to allow washing loads to be put in and out through the load inlet/outlet opening 101a. When this is done, the door 103 becomes projected forward from the 20 housing 101. On this account, use of the drum type washing machine involves a need for a space for the forward opening of the door 103 in addition to the space for the placement of the housing 101. Thus, the drum type washing machine cannot be used with a small space provided around the 25 housing 101, disadvantageously.

[0004] Also, the above conventional drum type washing machine involves putting in and out the loads with the door 103 opened and projected forward. This causes another problem that the door 103 opened forward of the housing 101 5 disturbs the work of putting in and out the loads.

SUMMARY OF THE INVENTION

[0005] Accordingly, an object of the present invention is to provide a washing machine which needs almost no space 10 around the housing and which is capable of improving the workability for putting loads in and out.

[0006] In order to achieve the above object, according to the present invention, there is provided a washing machine comprising:

15 a housing having a first opening portion;  
a water tank which is placed within the housing and which has a second opening portion facing the first opening portion of the housing;

20 an unbendable door at least part of which can be accommodated in the housing and which is slid vertically against the housing to open and close the first opening portion of the housing; and

at least one spring for biasing the door upward and braking downward sliding of the door.

[0007] In this washing machine, when washing loads are put in and out through the first opening portion, the door is slid against the housing so that the first opening portion of the housing is opened. Therefore, unlike conventional pivotal-type doors, the door never projects forward of the housing. Thus, there is no need for any large space in front of the housing, but a small empty space will do for use of this washing machine.

10 [0008] Furthermore, in this washing machine, the door, when opened, is slid and accommodated in the housing, thus making no obstacle to the work of putting in and out washing loads through the first opening portion, unlike conventional pivotal-type doors.

15 [0009] Also, the door is not grating-shaped, and unbendable. Thus, the door never bends but slides smoothly, being so good at feeling and allowing noise reduction to be achieved.

20 [0010] Also, since the door is unbendable, it never occurs that the door is bent to collide with the water tank or the like. That is, it never occurs that the door and the water tank or the like interfere with each other during the sliding of the door.

25 [0011] Also, in the case where the external wall of the housing in which the first opening portion is provided is

generally arc-shaped in its cross section, with the door generally arc-shaped in its cross section, the door can be slid along the external wall of the housing so as to be accommodated in the housing.

5 [0012] Also, since the door is slid vertically, the empty space within the lower portion of the housing can be effectively utilized, allowing a downsizing to be achieved.

[0013] Also, in the case where the door is accommodated within the lower portion of the housing, for example, the 10 door makes no obstacle to the provision of the display and operation parts on a top portion of the housing, so that the visibility and operability of the display and operation parts can be enhanced.

[0014] Also, since the door is biased upward by the 15 spring, the force required to slide the door upward is lessened. Thus, the user is allowed to manually slide the door upward with ease. That is, upward operating force for the door can be reduced.

[0015] Also, when the door slides downward by its 20 weight, the downward sliding of the door is braked by the spring, so that the door slides downward slowly. Thus, the occurrence that the door may rush and slide downward to collide with, for example, user's hands can be prevented, allowing the safety for the user to be enhanced.

[0016] In one embodiment of the washing machine, the spring is a flat spiral spring.

[0017] In the washing machine of this embodiment, since the spring is a flat spiral spring, the place where the 5 spring is mounted becomes narrower. That is, a space saving effect for the spring can be obtained.

[0018] In another aspect of the present invention, there is provided a washing machine comprising:

10 a housing having a first opening portion and an accommodating portion;

a water tank which is placed within the housing and which has a second opening portion facing the first opening portion of the housing;

15 an unbendable door at least part of which can be accommodated in the accommodating portion of the housing and which is slid vertically against the housing to open and close the first opening portion of the housing; and

20 a cover which covers a front face of the accommodating portion and which is attachable to and removable from the housing.

[0019] In the washing machine of this embodiment, opened, when washing loads are put in and out through the first opening portion, the door is slid against the housing so that the first opening portion is opened. Therefore, 25 unlike conventional pivotal-type doors, the door never

projects forward of the housing. Thus, there is no need for any large space in front of the housing, but a small empty space will do for use of this washing machine.

5 [0020] Furthermore, in this washing machine, the door, when opened, is slid and accommodated in the housing, thus making no obstacle to the work of putting in and out washing loads through the first opening portion, unlike conventional pivotal-type doors.

10 [0021] Also, the door is not grating-shaped, and unbendable. Thus, the door never bends but slides smoothly, being so good at feeling and allowing noise reduction to be achieved.

15 [0022] Also, since the door is unbendable, it never occurs that the door is bent to collide with the water tank or the like. That is, it never occurs that the door and the water tank or the like interfere with each other during the sliding of the door.

20 [0023] Also, in the case where the external wall of the housing in which the first opening portion is provided is generally arc-shaped in its cross section, with the door generally arc-shaped in its cross section, the door can be slid along the external wall of the housing so as to be accommodated in the housing.

[0024] Also, since the door is slid vertically, an empty space within a lower portion of the housing can be effectively utilized, allowing a downsizing to be achieved.

[0025] Also, in the case where the accommodating portion 5 is located in a lower portion of the housing, for example, the door makes no obstacle to the provision of the display and operation parts on a top portion of the housing, so that the visibility and operability of the display and operation parts can be enhanced.

[0026] In the event that any foreign matters have 10 entered into the accommodating portion, the washing machine includes the cover which covers a front face of the accommodating portion and which is attachable to and removable from the housing, the user is allowed to remove 15 the accommodating portion to take out the foreign matters. That is, the washing machine can be enhanced in maintainability.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Fig. 1 is a schematic sectional view of a drum 20 type washing machine according to an embodiment of the present invention with its first door closed;

[0028] Fig. 2 is a schematic front view of the drum type 25 washing machine according to an embodiment of the invention with its first door closed; and

[0029] Fig. 3 is a view of a drum type washing machine according to a prior art with as viewed obliquely from above.

[0030] (Reference Symbols)

5           1: housing  
              2: opening portion of the housing 1  
              3: first door  
              4: water tank  
              4a: opening portion of the water tank 4  
10          5: rotating drum  
              6: second door  
              7: motor  
              8: door cover  
              10: flat spiral spring

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DETAILED DESCRIPTION OF THE INVENTION

[0031] Hereinbelow, the washing machine of the present invention will be described in detail by an embodiment illustrated in the accompanying drawings.

20          [0032] Fig. 1 shows a schematic sectional view of a drum type washing machine according to an embodiment of the invention with its first door 3 closed.

[0033] The drum type washing machine includes a housing 1, a bottomed cylindrical-shaped water tank 4 set within  
25        the housing 1, a bottomed cylindrical-shaped rotating drum

5 which is set within the water tank 4 and which accommodates washing loads, a motor 7 which is mounted in the rear of the water tank 4 and which drives the rotating drum 5 into rotation, and a transparent, unbendable first 5 door 3 as an example of the door.

[0034] At a top portion of the housing 1, an operation panel 11 having operation keys and a display part is provided. On the rear side (water tank 4 side) of the operation panel 11, a control unit 2 for controlling the 10 operation of the drum type washing machine is placed. The front face of the housing 1 is a curved surface, and a forward portion of the housing 1 is generally arc-shaped in its cross section. Then, the front face of the housing 1 has, in its upper portion, an opening portion 1a through 15 which washing loads are passed. Also, a removable door cover 8 is attached to a lower portion of the front face of the housing 1. The opening portion 1a is opened and closed by the first door 3, which is slidable vertically against the housing 1.

20 [0035] The front and rear faces of the first door 3 are curved surfaces, and a cross section of the first door 3 is generally arc-shaped. Also, four sliders 12 that allow the first door 3 to slide vertically are mounted at edge portions of the first door 3. In more detail, the sliders 25 12 are fixed at an upper portion of one side portion of the

first door, a lower portion of the one side portion of the first door, an upper portion of the other side portion of the first door, and a lower portion of the other portion of the first door, respectively, each one in number. The 5 sliding of the first door 3 is effected by user's hand. That is, the first door 3 is to be vertically slid manually by the user. For this purpose, a grip 15 (see Fig. 2) is provided at the front face of the first door 3 for enhanced operational maneuverability of the first door 3. Also, the 10 first door 3, when slid downward, can be generally entirely accommodated between the door cover 8 and lower portion of the front face of the housing 1. That is, the generally entirety of the first door 3 can be accommodated in an accommodating portion provided in lower portion of the 15 front face of the housing 1, and a front face of this accommodating portion is covered with the door cover 8. Further, the first door 3 keeps closing the opening portion 1a of the housing 1 during washing operation and dehydrating operation. During these operations, the first 20 door 3 is locked by a door lock unit (not shown). However, upon a power failure during the operations, for example, the first door 3 is released from locking automatically, thus allowing the first door 3 to be opened and closed manually.

[0036] The door cover 8 has a claw 8a which is to be engaged with a lower end of the front face of the housing 1. Pressing the claw 8a causes the claw 8a to be disengaged from the lower end of the front face of the housing 1, so that the door cover 8 can be easily removed from the lower portion of the front face of the housing 1.

[0037] The water tank 4 is installed transversely with a slight slant so that its opening portion 4a faces the opening portion 1a of the housing 1. In more detail, a center axis of the water tank 4 is slanted so as to form an angle of 5° to 30° against the horizontal direction. The opening portion 4a of the water tank 4 and the opening portion 1a of the housing 1 are opposed to each other with a spacing therebetween. Further, the water tank 4 has a transparent, hinge-type second door 6 pivotably mounted thereon. With the opening portion 4a of the water tank 4 closed by the second door 6, liquid within the water tank 4 can be prevented from leaking out of the water tank 4. Also, the second door 6 has a glass window 6a which becomes projected inward of the rotating drum 5 when the opening portion 4a of the water tank 4 is closed. The opening portion 4a is an example of a second opening portion.

[0038] The rotating drum 5 is so positioned that a rear side of its rotational axis (i.e., depth side of the rotating drum 5) is lowered, namely, the rotational axis

descends toward the rear side. In more detail, the rotational axis of the rotating drum 5 is generally parallel to the center axis of the water tank 4 and slanted so as to form an angle of 5° to 30° against the horizontal 5 direction. Also, a plurality of small holes 5a provided all over the peripheral wall of the rotating drum 5 are intended to allow washing water or the like to be circulated between a space formed between the water tank 4 and the rotating drum 5 and a space present within the 10 rotating drum 5.

[0039] Further, on both sides of the opening portion 1a of the housing 1 is provided a spring unit 9 having flat spiral springs 10 as an example of the spring. By making use of spring force of the flat spiral springs 10, the 15 first door 3 is biased upward while downward sliding of the first door 3 is braked.

[0040] Fig. 2 shows a schematic front view of the drum type washing machine with its first door 3 closed.

[0041] The individual sliders 12 fitted at upper 20 portions of both side portions of the first door 3 have wires 13 fixed thereto by one end. Meanwhile, the other end of each wire 13 is fixed to a reel (not shown) within the spring unit 9. The wire 13 can be wound on this reel or pulled out from the reel. The reel is biased by the

flat spiral spring 10 toward the winding direction of the wire 13.

[0042] Further, rails 14 are provided on both sides of the first door 3, where the sliders 12 are slidably fitted 5 to these rails 14. Thus, the first door 3 can be slid vertically along the rails 14.

[0043] According to the drum type washing machine of the above construction, when washing loads are put in and out through the opening portion 1a of the housing 1, the first 10 door 3 is slid against the housing so that the opening portion 1a of the housing 1 is opened. Therefore, unlike conventional pivotal-type doors, the first door 3 never projects forward of the housing 1. Thus, there is no need for any large space in front of the housing 1, but a small 15 empty space will do for use of this drum type washing machine.

[0044] Furthermore, in this washing machine, the first door 3, when opened, is slid and accommodated in the housing, thus making no obstacle to the work of putting in 20 and out washing loads through the opening portion 1a of the housing 1, unlike conventional pivotal-type doors.

[0045] Also, the first door 3 is not grating-shaped, and unbendable. Thus, the first door 3 never bends but slides smoothly, being so good at feeling and allowing noise 25 reduction to be achieved.

[0046] Also, since the first door 3 is unbendable, the first door 3 does not bent to collide with the water tank 4 or the like. That is, the first door 3 and the water tank 4 or the like do not interfere with each other during the 5 sliding of the first door 3.

[0047] Also, since forward portion of the housing 1 is generally arc-shaped in its cross section and the first door 3 is generally arc-shaped in its cross section, the first door 3 can be slid without being brought into 10 collision with the forward portion of the housing 1 so that the generally entirety of the first door 3 can be accommodated between the door cover 8 and the lower portion of the front face of the housing 1.

[0048] Also, since the first door 3 is slid vertically, 15 an empty space within the lower portion of the housing 1 can be effectively utilized, allowing a downsizing to be achieved.

[0049] Also, since the generally entirety of the first door 3 can be accommodated between the door cover 8 and the 20 lower portion of the front face of the housing 1, the first door 3 makes no obstacle to the provision of the operation panel 11 on a top portion of the housing 1, so that the visibility and operability of the display and operation parts of the operation panel 11 can be enhanced.

[0050] Also, as shown in Fig. 2, to close the opening portion 1a of the housing 1 by the first door 3, the user makes the first door 3 slid upward manually. When this is done, the first door 3 is biased upward upon reception of 5 spring force of the flat spiral springs 10 via the wires 13. That is, the upward sliding of the first door 3 is aided by the spring force of the flat spiral springs 10. Accordingly, the force required to slide the first door 3 upward is lessened. Thus, the user is allowed to manually 10 slide the first door 3 upward with ease. That is, upward operating force for the first door 3 can be reduced.

[0051] Also, for the closing of the opening portion 1a of the housing 1 with the first door 3, the user makes the first door 3 slid downward manually so that the first door 15 3 is moved to a position depicted by two-dot chain line. In this case, with the spring force of the flat spiral springs 10 exerted on the first door 3 via the wires 13, the downward sliding of the first door 3 is braked. As a result, the first door 3 is slid downward slowly, 20 preventing the first door 3 from rushing and sliding downward to collide with, for example, user's hands. Thus, safety for the user can be enhanced.

[0052] The flat spiral springs 10 as an example of the spring for aiding the upward sliding of the first door 3 or 25 braking the downward move of the first door 3 can be

settled at a small space. That is, a space saving effect for the flat spiral springs 10 can be obtained.

5 [0053] In the event that any foreign matters have entered between the door cover 8 and lower portion of the front face of the housing 1, removing the door cover 8 from the lower portion of the front face of the housing 1 allows the user to take out the foreign matters easily. That is, the drum type washing machine can be enhanced in maintainability.

10 [0054] Although two flat spiral springs 10 are used in the above embodiment, yet one flat spiral spring or three or more flat spiral springs may be used.

[0055] Also, a plate spring or coil spring or the like may be used instead of the flat spiral spring 10.

15 [0056] Further, the drum type washing machine may be equipped with a drying unit for drying washing loads. That is, the present invention is applicable not only to washing machines having the drying function as a matter of course, but also to washing machines having no drying function.